

Waterbird Response to Restoration Efforts: Managed vs. Breached Ponds

Tanya Graham, Susan De La Cruz, and Laurie Hall
U.S. Geological Survey, Western Ecological Research Center
San Francisco Bay Estuary Field Station

SF Bay-Delta: Critical for wintering and migrating birds

- Western Hemisphere Shorebird Reserve Network – over half a million migrating shorebirds
- Key diving duck wintering area - 40 and 50% of Pacific Flyway scaup and scoter counted in SFB during midwinter
- North and South Bay salt ponds - important winter habitat components
 - 40% of Bay waterfowl in South Bay ponds
 - 15% in North Bay ponds (*Richmond et al. 2014*)



Napa-Sonoma Marsh Restoration Project

Goals:

Restore a mosaic of habitats ranging from tidal marsh to open ponds that balance needs of marsh species with migratory shorebird and waterfowl populations

Central challenge:

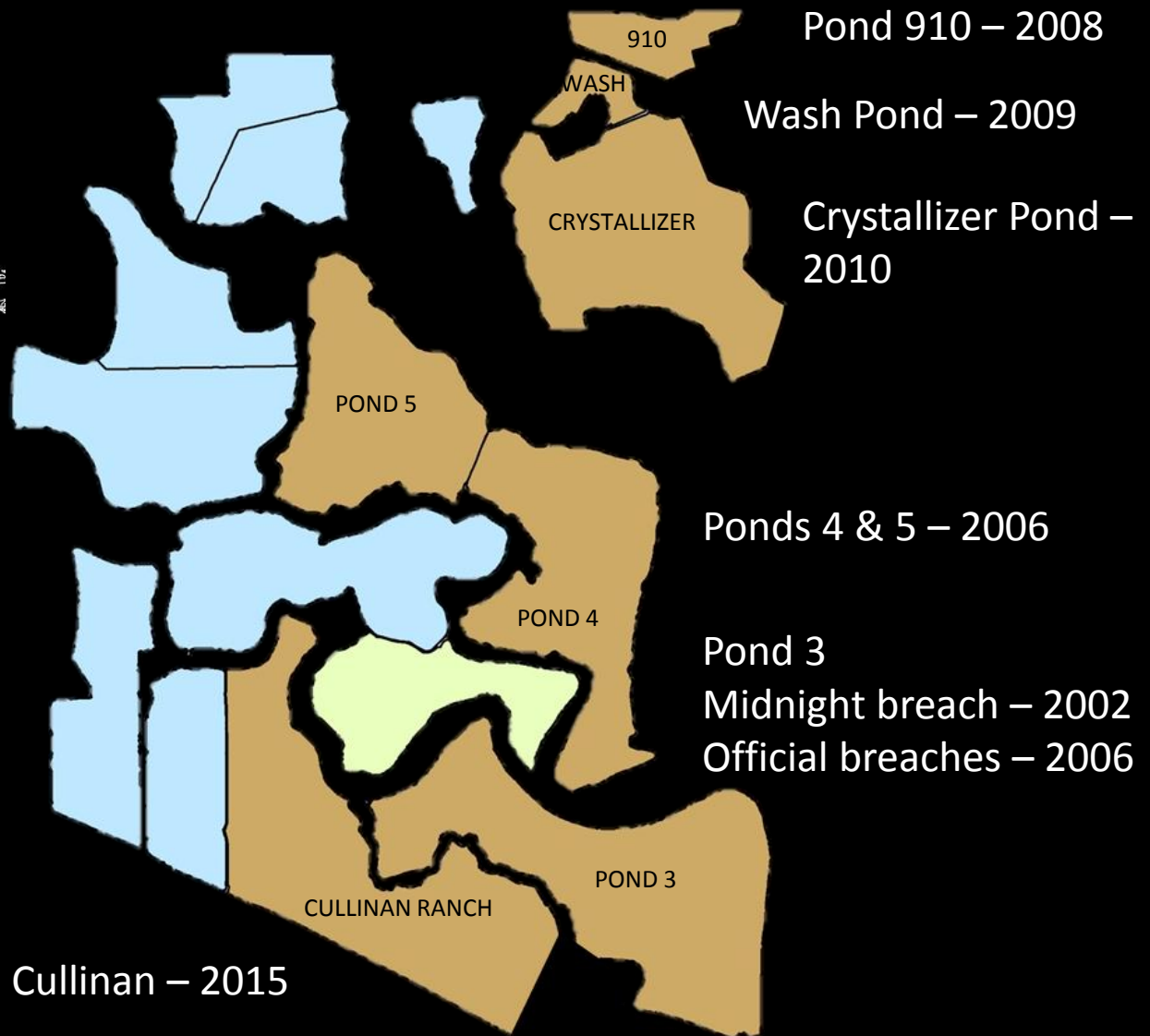
How to maintain waterbird populations given conversion to tidal marsh?



North Bay Pond Restoration



61% of area of North Bay ponds is breached



Questions

- How have restoration efforts affected waterbird abundances on breached and managed ponds?
- What pond characteristics are important to different avian guilds?



Methods

Data collection

- Monthly counts at HT
 - Dec 2002 – May 2017
- Monthly counts at LT
 - May 2008 – May 2017
- Water quality
 - Dissolved Oxygen (mg/L)
 - Salinity (ppt)



Methods

Data Analysis

- GLMM
 - Pond Area
 - Pond Type
 - Managed or Breached
 - Water Quality
 - Dissolved Oxygen
 - Salinity
 - Random Effects: Year, Pond
 - Time Since Breaching

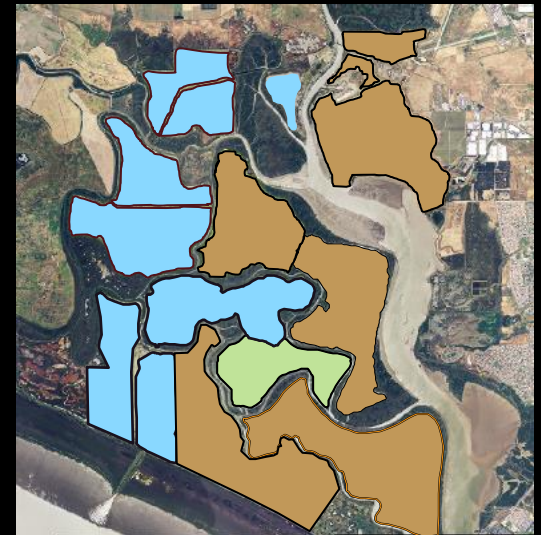
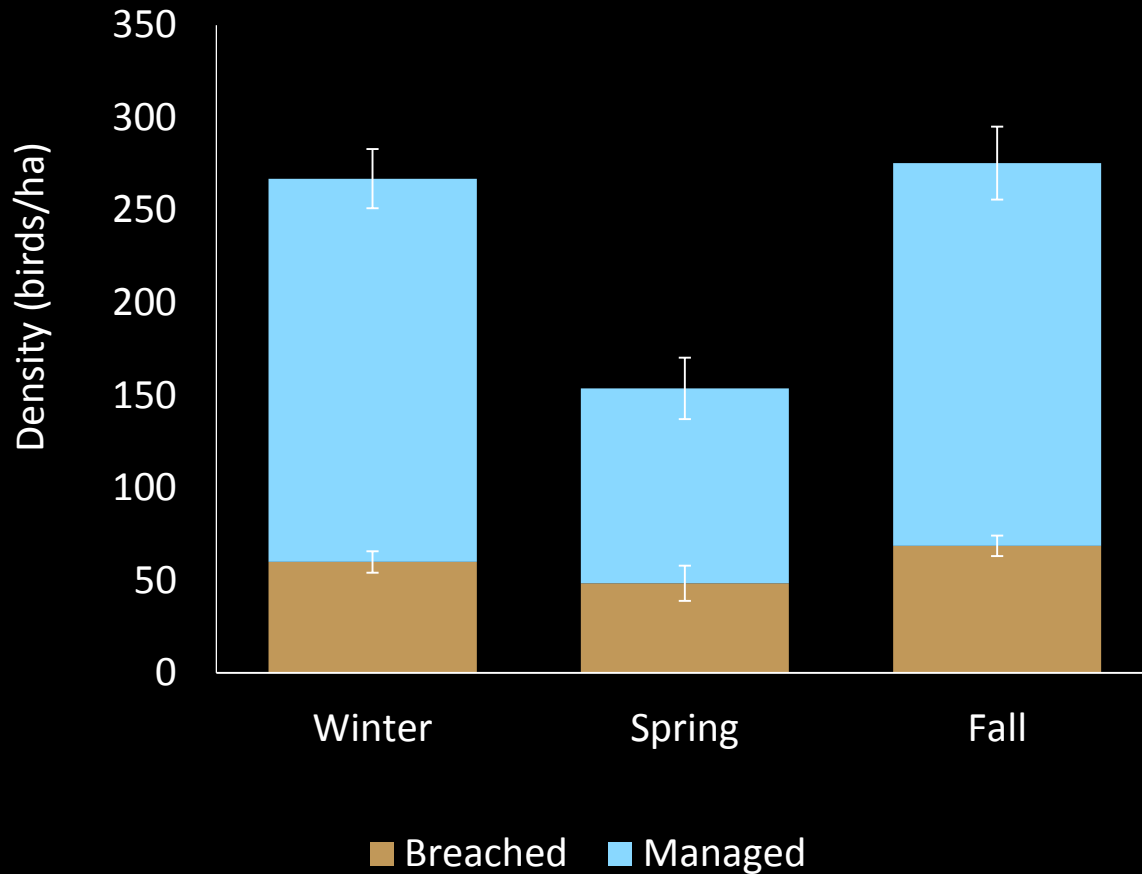


Avian Guilds



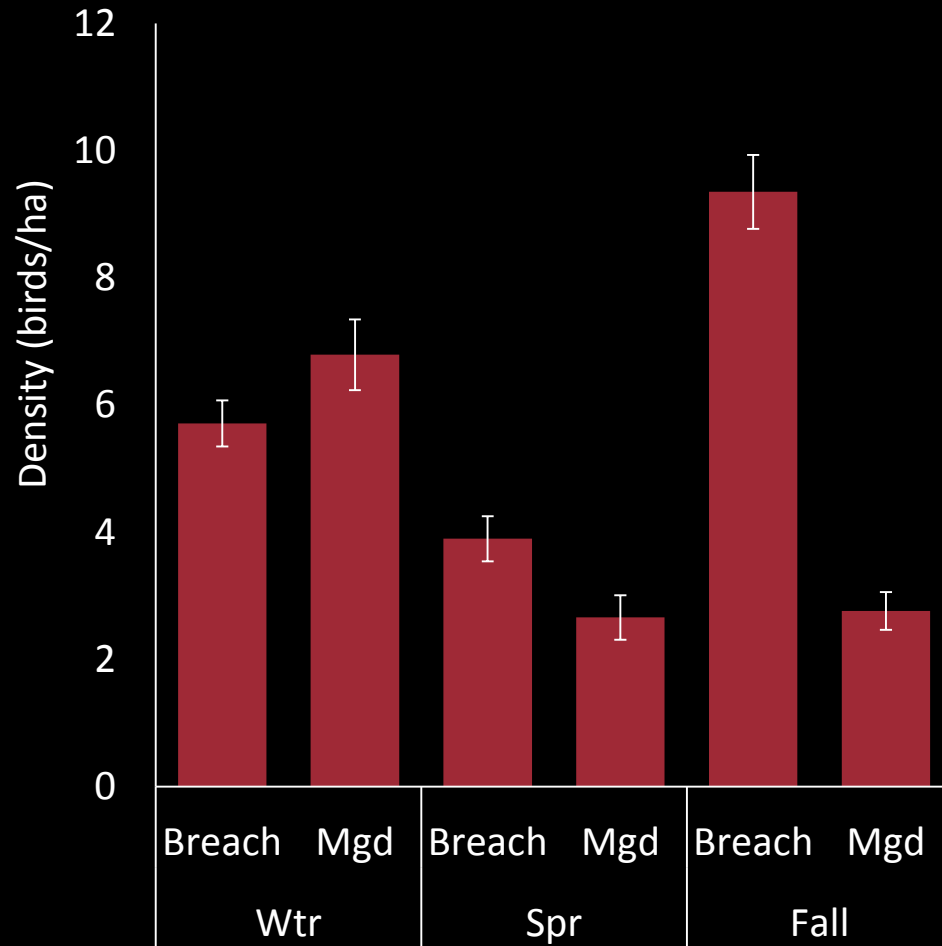
Drawing adapted from Warnock 2004

Results: Seasonal Density HT

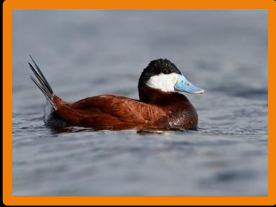




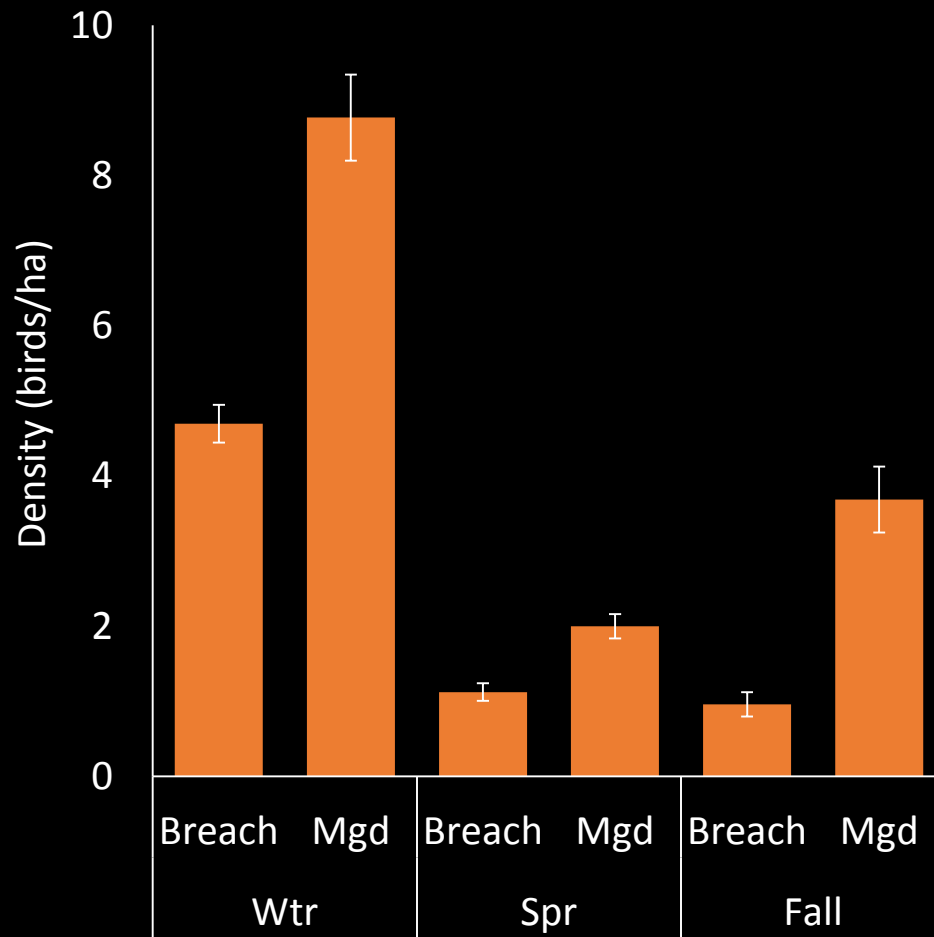
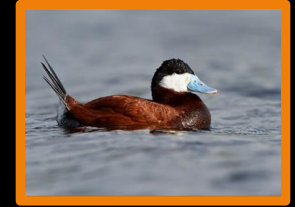
Results: Dabbling Ducks HT



Fixed Effect	Foraging	Roosting
Intercept	+	+
Pond Type: Managed	+	
Pond Area	+	+
Season: Spring	-	-
Season: Winter		
Dissolved Oxygen		
Salinity	-	-



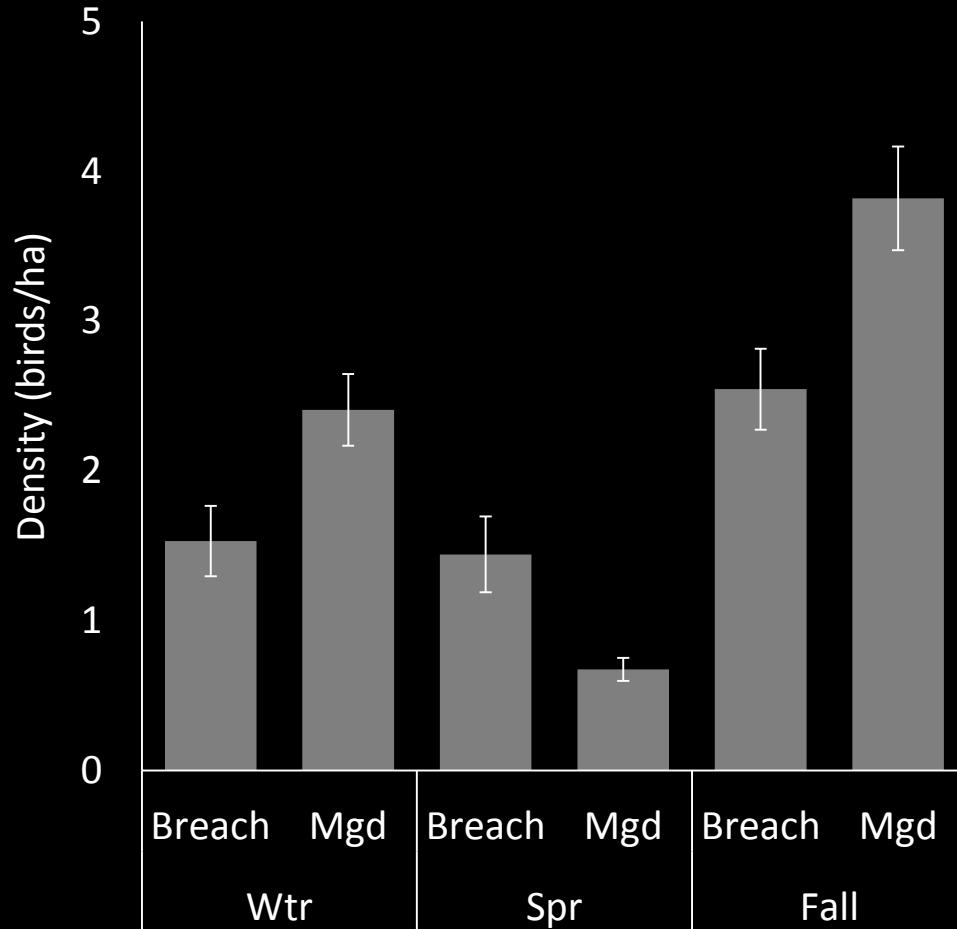
Results: Diving Ducks HT



Fixed Effect	Foraging	Roosting
Intercept	+	+
Pond Type: Managed	+	+
Pond Area	+	+
Season: Spring	+	-
Season: Winter	+	+
Dissolved Oxygen		
Salinity	-	-



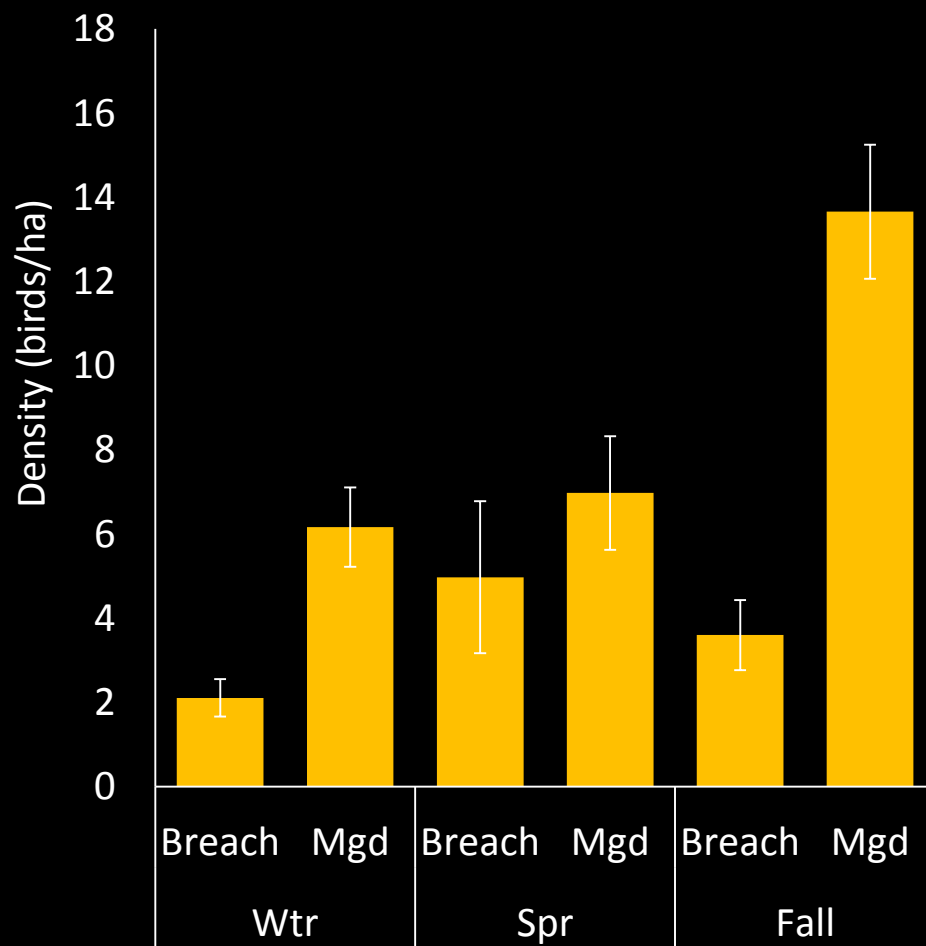
Results: Medium Shorebirds HT



Fixed Effect	Foraging	Roosting
Intercept	+	+
Pond Type: Managed	+	+
Pond Area		
Season: Spring	-	-
Season: Winter	-	-
Dissolved Oxygen		
Salinity	-	-

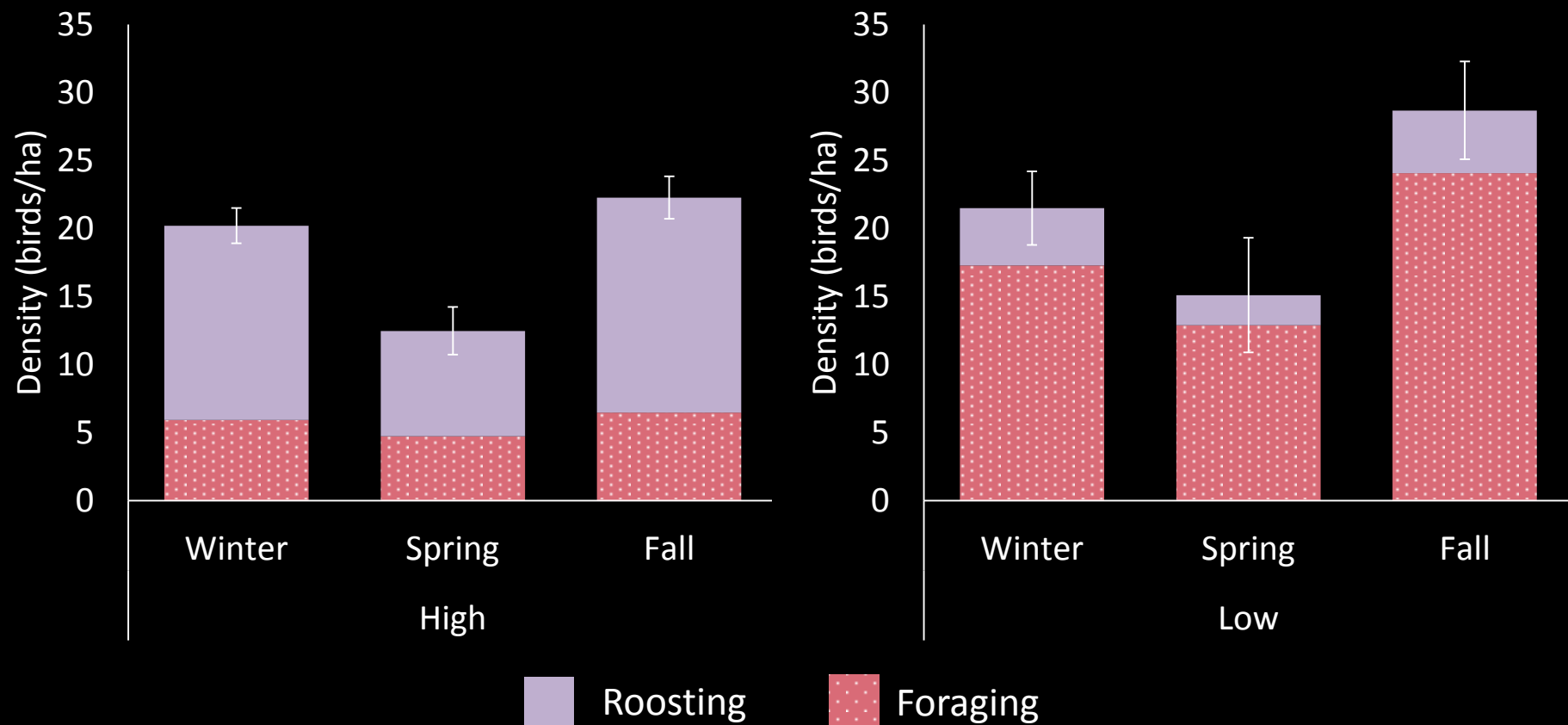


Results: Small Shorebirds HT



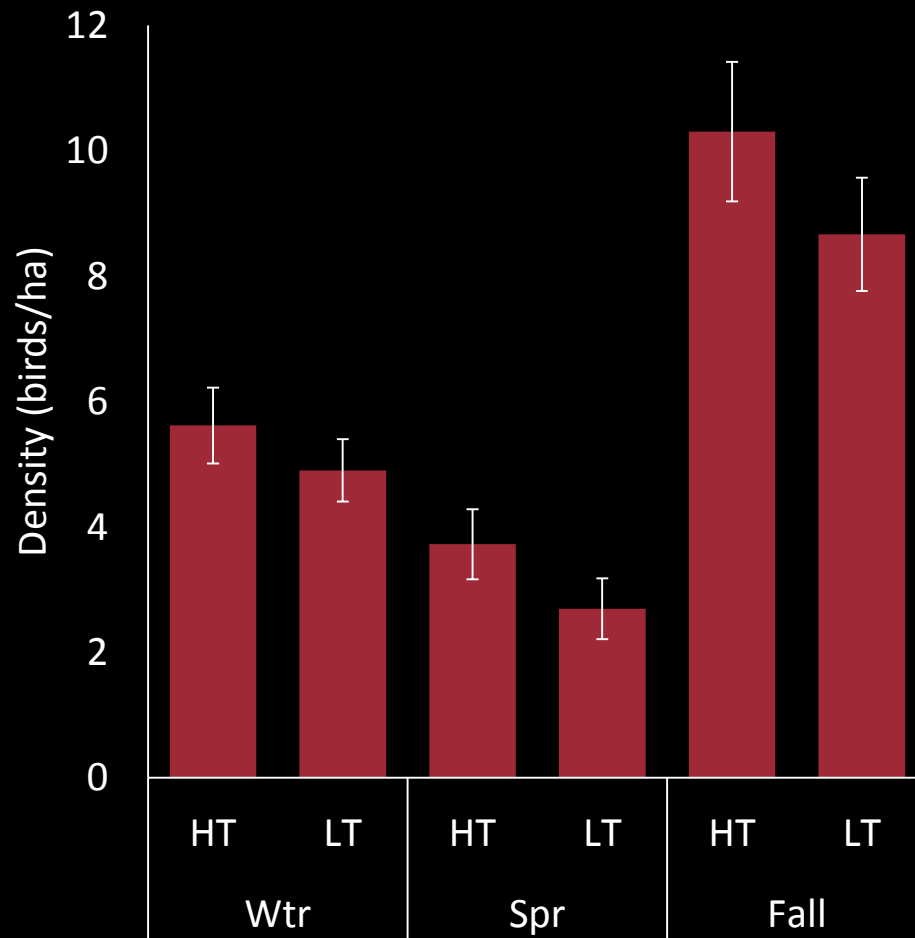
Fixed Effect	Foraging	Roosting
Intercept	+	+
Pond Type: Managed	+	+
Pond Area		
Season: Spring	-	-
Season: Winter		-
Dissolved Oxygen		
Salinity	-	

Results: Seasonal Density Breached Ponds

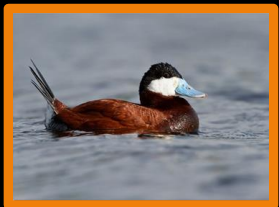




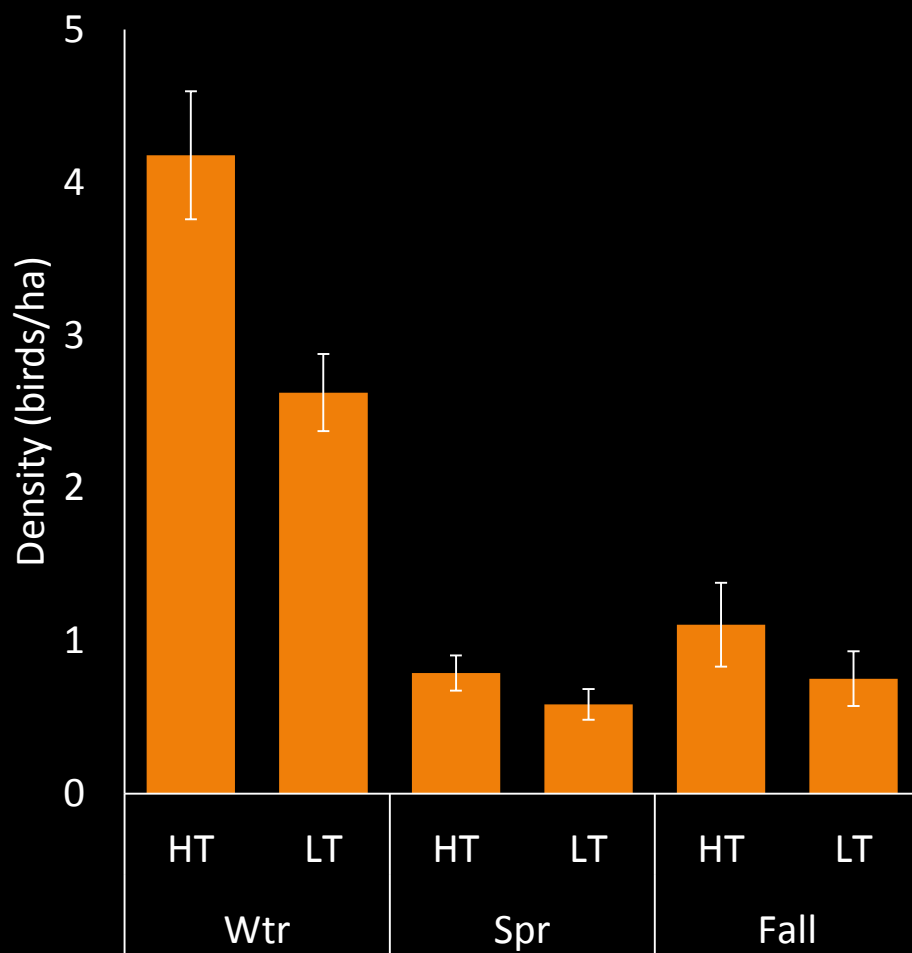
Results: Dabbling Ducks Breached



Fixed Effect	Foraging	Roosting
(Intercept)	+	+
Tide Category: Low	+	-
Pond Area	+	+
Season: Spring	-	-
Season: Winter	-	-
Days Since Breached		



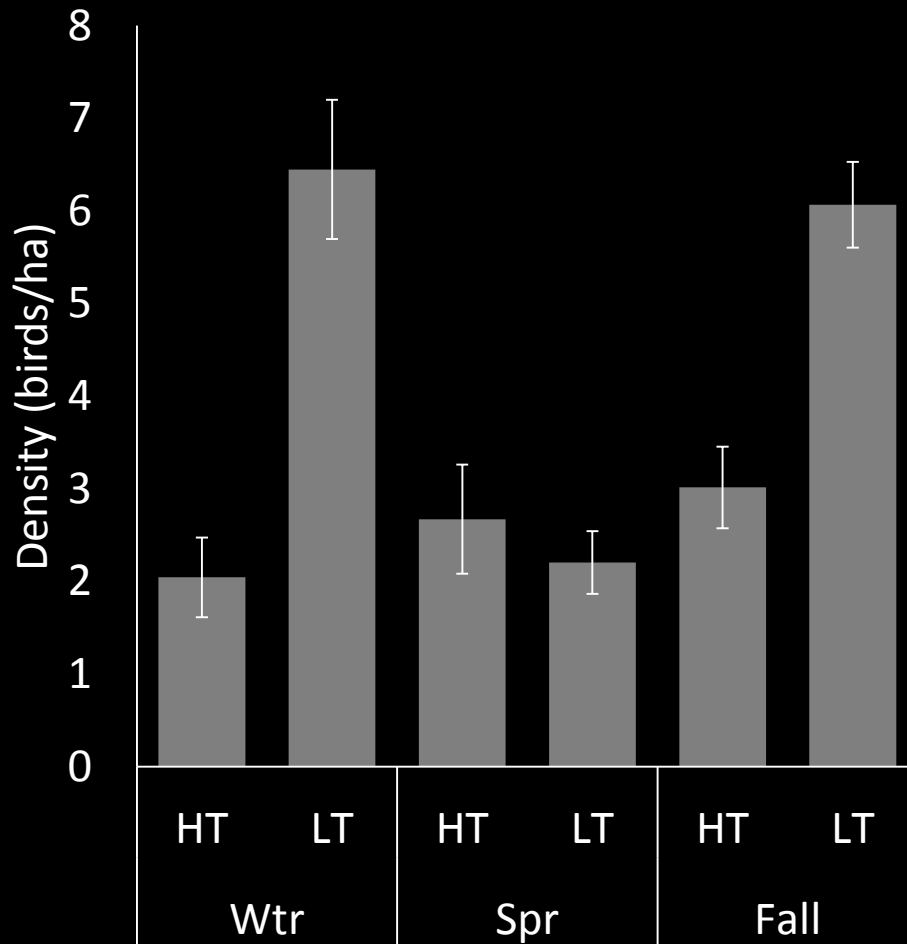
Results: Diving Ducks Breached



Fixed Effect	Foraging	Roosting
(Intercept)	+	+
Tide Category: Low	-	-
Pond Area	+	+
Season: Spring	+	+
Season: Winter	+	+
Days Since Breached		



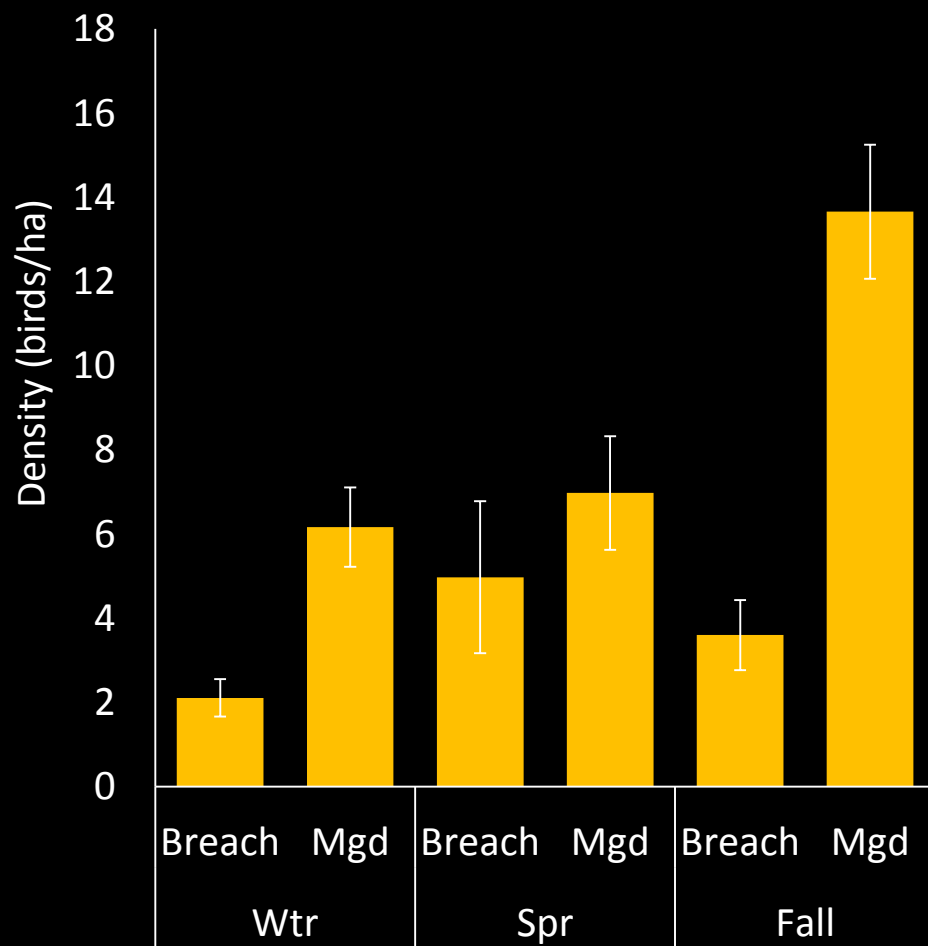
Results: Medium Shorebirds Breached



Fixed Effect	Foraging	Roosting
(Intercept)	+	+
Tide Category: Low	+	-
Pond Area		
Season: Spring	-	-
Season: Winter		-
Days Since Breached	+	



Results: Small Shorebirds Breached



Fixed Effect	Foraging	Roosting
(Intercept)	+	+
Tide Category: Low	+	-
Pond Area	+	+
Season: Spring		
Season: Winter		-
Days Since Breached		

Conclusions

- Season
 - More divers in winter and spring
 - More dabblers and shorebirds in fall
- Pond Type
 - Waterbirds used breached ponds for foraging at LT, and roosting at HT
 - More foraging and roosting waterbirds on managed ponds at HT (except roosting dabblers)
- Pond Size
 - Larger ponds were important for waterfowl
 - Larger breached ponds were important for small shorebirds

Conclusions

- Salinity
 - More foraging and roosting in lower salinity ponds
 - Roosting small shorebirds had no relation w/ salinity
- Days Since Breach
 - Medium shorebirds foraged more on older breached ponds
- Dissolved Oxygen
 - DO not significant

Management Implications

Pond 3 October 2006



Pond 3 October 2017



- Waterbirds are using breached ponds
 - Loss of shallow habitats may yield increased pressure on managed pond resources
- Research suggestions
 - LT abundance on managed and breached ponds
 - Bathymetric and sediment deposition studies of breached ponds
 - Inclusion of sea level rise estimates in tidal marsh transition modelling

Acknowledgements

John Takekawa, Nicole Athearn, L. Arriana Brand, Kathleen Henderson, Lacy Smith

Field Crew:

K. Barry, S. Bishop, J. Bluso, E. Bonczek, W. Chan, L.A. Curry, M. Czapanskiy, L. DeMais, L. Dembosz, D. Drolette, K. Dudley, T. Edgarian, P. Elsen, E. Garfinkle, P. Gibson, K. Goodenough, D. Haines, B. Hattenbach, M. Hill, L. Hollander, M. Lau, K. Mogensen, D. Nelson, S. Piotter, C. Reyes, A. Rowan, A. Schultz, J. Shinn, A. Schults, K. Spragens, B. Stieg-Wensky, L. Terrazas, K. Woodward and others

Management Agencies: USFWS, CDFW

Collaborators: Ducks Unlimited, USACE, GAIA, Moss Landing Marine Labs